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From Knowing It to “Getting It”: Envisioning Practices in Computer Games Development

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The development of information systems and software applications increasingly needs to deliver culturally rich and affective experiences for user groups. In this paper, we explore how the collaborative practices across different expert groups can enable this experiential dimension of use to be integrated into the development of a software product. In an empirical study of computer games development—an arena in which the novelty and richness of the user experience is central to competitive success—we identify the challenges of conceptualizing and realizing a desired user experience when it cannot be readily specified in an initial design template, nor represented within the expertise of existing groups. Our study develops a theoretical framework to address these challenges. Through this framework, we are able to show how achieving a desired user experience requires developer groups to not only work across the boundaries that arise from specialized expertise, but also across wider fields centred on cultural production and software development, respectively. We find that their ability to do this is supported by distinctive “envisioning practices” that sustain an emerging shared “vision” for each game. The key research contributions that we then make are (a) grounding envisioning practices as a means of theorizing the collaborative practices centred on conceptualizing the user experience; (b) identifying how these practices are interwoven with the “producing practices” of software development, thus enabling collaboration to span expert groups and disparate fields; and (c) theorizing the role of vision as an emerging conceptual boundary object in these practices.

Key words: collaborative practice; envisioning; interpretive; computer games development; emergence

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1. Introduction

The complex relationship between the development of a software product and its application by user groups is a central problem in the information systems (IS) field. As elucidated by important theoretical contributions (Orlikowski 2000, Lamb and Kling 2003, Leonardi and Barley 2010), this relationship is far from deterministic or predictable, and consequently poses significant challenges for the collaborative practices of software development teams as they try to make sense of the possible user responses to their offerings (Rip et al. 1995, Brown et al. 2008). These challenges are well understood in relation to conventional software applications where the emphasis is on productive use within organizational settings with well-defined user roles (e.g., Boudreau and Robey 2005). However, this conventional understanding is arguably less relevant to the increasingly widespread uses of software that lie outside the organizational domain (Wasko et al. 2011). Here, recent studies have contrasted what can broadly be termed the “experiential” use of software with its productive use centred on organizational control and efficiency (Hassenzahl and Tractinsky 2006,

Van der Heijden 2004). Experiential use is viewed as conferring intrinsic rather than extrinsic benefits on the user (Deci 1975), with performance criteria centring on user immersion and extended duration of use rather than the speed and efficiency associated with productivity-oriented applications (Hsu and Lu 2004, Van der Heijden 2004). As some evidence suggests that the experiential aspect of use may overlap with its productive aspect (Agarwal and Karahanna 2000), this term will be defined here as denoting a *dimension* rather than a discrete *form* of use. Indeed, as indicated by current interest in “gamification” (Deterding et al. 2011, Thom et al. 2012), this experiential dimension of use is increasingly being integrated into conventional and business-oriented systems to improve user engagement. Recent studies suggest, though, that applications where the experiential dimension of use predominates impose new demands on the creativity and collaborative practices of software development teams. This is because such software needs to be interactive, “immersive” and aesthetically pleasing to stimulate and engage the user (Lin and Bhattacharjee 2010), including “virtual worlds” or “hyperreal” environments that allow users

to create new meanings through their use (Aoyama and Izushi 2003; Schultze and Orlikowski 2010; Wasko et al. 2011; Schultze 2010, 2011).

In this paper, we address the theoretical and practical implications of this experiential dimension of software use for the collaboration involved in software development. We build on previous studies that have adopted a practice-based approach to the collaborative development of innovation (Carlile 2002; Levina and Vaast 2005; Nicolini 2009; Orlikowski 2000, 2010), and pose the broad question of how collaborative practices across different expert groups can enable the experiential dimension of use to be integrated into the development of a software product. To address this question, we focus our study empirically on the software development process in the computer games sector. For the innovative and highly sophisticated software products developed in this sector, “atmosphere,” “style,” “drama,” and “gameplay” are central to the user experience (Cohendet and Simon 2007, Johnson and Wiles 2003, Roberto and Carioggia 2003, Tschang 2007) and are seen as creating distinctive challenges for collaboration (Stacey and Nandhakumar 2009; Tschang 2007; Zackariasson et al. 2006a, b).

The paper is organized as follows. First, we review the literature on collaborative practices in the exemplary setting of the computer games sector. This illuminates the distinctive challenges that apply to software development in this setting, and the limitations of existing theoretical perspectives. In so doing, we also draw on insights regarding collaborative work in “cultural industries,” including movies and architectural design, which lie outside the mainstream IS literature, but that are aligned with computer games in their efforts to produce rich and culturally mediated experiences for their users. Second, we develop a theoretical framework to address such challenges by drawing on existing studies, which have highlighted the difficulties of overcoming boundaries between diverse expert groups, and the role played by the “framing” of technology in shaping its design and development. We then turn to the analysis of our empirical study of computer games development. The subsequent discussion section relates our empirical findings to existing theoretical perspectives to develop a novel understanding of collaborative practices in the distinctive games development setting. Finally, we identify the implications of this novel understanding for future research and practice.

2. Distinctive Challenges of Computer Games Development

As Chiasson and Davidson (2005) note, industry characteristics provide an important context and inspiration for research in the information systems field.

Accordingly, we identified the computer games sector as not only worthy of attention in its own right, (being the largest global entertainment industry in terms of revenue (PricewaterhouseCoopers 2008)), but as also representing an “extreme” and under-researched case, exhibiting distinctive and innovative developments in practice (Eisenhardt 1989, Pettigrew 1990). To date, relatively few studies in the IS field have addressed the collaborative practices involved in developing computer games. This reflects the ambiguous positioning of this sector as a field of practice. Computer games development is often viewed as a “creative industry” (Potts et al. 2008), and the efforts of games developers are equally likely to be viewed through the lens of creativity or media studies as they are in terms of collaborative software development (Green et al. 2007). From the small number of existing studies, however, it is possible to identify important implications flowing from the experiential dimension of use into development practices. For one, the experiential dimension of game playing is interactive and therefore difficult to conceptualize and represent, especially in early stages of design. As one study notes: “Due to their interactive nature, it is difficult to gauge players’ ultimate reactions to such a product while it is under development... sometimes until the game has nearly been completed” (Tschang and Szczypula 2006, p. 276). In addition, the experiential dimension of use requires the blending of cultural, affective, and aesthetic features into a user experience that is self-consistent, immersive, and interpretively satisfying for the user (Aoyama and Izushi 2003, Hassenzahl and Tractinsky 2006, Schultze and Orlikowski 2010, Van der Heijden 2004).

In many established cultural industries there is what can be termed an “authorial” solution to this challenge whereby the intentions of a creative individual are translated directly through the product of that individual to the reader or viewer (Braudy and Cohen 2004, Csikszentmihalyi 1991). Even where multiple expert groups are involved, as, for example, in movie-making, such an authorial solution still informs collaboration through a hierarchically structured role system centred on the movie’s “director” (Bechky 2006). However, this authorial solution is less relevant to computer games development because this is an arena in which creativity is more collective (Hargadon and Bechky 2006), being mobilized through a development process that incorporates multiple specialist groups, including programmers, artists, and scripters (Tschang 2007). Achieving the desired user experience, therefore, involves not only organizing diverse forms of expertise and attaining a certain technical functionality, but also achieving the desired cultural and affective features of the game. In consequence, software development tends to proceed in an

emergent way, as teams strive to produce a novel and satisfying experience for the user. Compared to more authorial settings such as movies, collaboration is based less on hierarchy and formal roles and more on reciprocal interactions among a wide range of expert groups (Faraj and Sproull 2000, Okhuysen and Bechky 2009).

In more conventional industrial applications, such close collaboration is typically supported by a detailed design specification (Byrd et al. 1992, Carroll 1995, Jarke and Pohl 1993). However, the experiential dimension of game use tends to preclude the detailed specification of product design in the early stages of software development (Cohendet and Simon 2007, Stacey and Nandhakumar 2009, Tschang and Szczypula 2006, Zackariasson et al. 2006b). In the absence of detailed specifications, studies suggest that the conceptualization of game design is reliant on an emerging “concept” or “vision” that helps different groups to evoke and share desired features of the game-playing experience (Stacey and Nandhakumar 2009; Zackariasson et al. 2006a, b).

3. Theoretical Development

In this section we address the collaborative challenges illustrated above by building on previous studies to conceptualize the collaboration involved in computer games development. As noted, one such challenge relates to the need for collaboration across multiple expert groups. Important work on this challenge includes Carlile’s study of new product development within an auto producer. This study found that the divisions in practice within this organization between different professional groups created “knowledge boundaries” to collaboration (Carlile 2002, 2004). Overcoming these involved the development of practices through which expert groups could identify their dependencies and develop a common language and understanding. The effectiveness of such practices was seen as closely linked to the development and sharing of “boundary objects” that, through their ability to “inhabit several intersecting social worlds...and satisfy the informational requirements of each of them” (Star and Griesemer 1989, p. 393), enabled different groups to represent their expertise to each other. Such objects can take multiple forms, including databases, prototypes, and technical drawings. Carlile observes, for example, how the use of design drawings in an interaction between a design engineer and a manufacturing engineer concerning an auto part’s development “supported a process where the group could define a shared problem (...) begin transforming their knowledge (the current design) and accommodating new knowledge (four subassemblies with snap-fit holes and clips)” (Carlile 2004, p. 450).

This emphasis on the need for collaborative practices to span the boundaries between different expert groups has been highlighted in studies of engineering-based settings where the roles of different functions or individuals and the requirements of different subsystems are well defined (Bechky 2003, Carlile 2002). This emphasis, however, has been questioned by studies from other settings where the work process is more emergent (Majchrzak et al. 2011, Kellogg et al. 2006). This emergent quality is particularly pronounced in computer games development, but is also found in other settings characterized by a strong emphasis on design, including architectural design (Boland et al. 2007; Ewenstein and Whyte 2007, 2009).

3.1. Different Roles of Boundary Objects

Carlile’s study emphasizes the capacity of concrete and well-defined boundary objects to represent the expertise of one group to another by making visible (syntactically, semantically, and pragmatically) the aspects of the common endeavour that are of central importance to each. In this way, the knowledge boundaries created by divisions of practice can be taken into account, addressed, and bridged in order to enable collaboration, thereby creating the “political momentum” needed to make choices between design paths (Bergman et al. 2007). In contrast to this emphasis on bridging existing boundaries, other studies have begun to explore the role of boundary objects in the development of knowledge. In a study of an architectural design project, Ewenstein and Whyte (2009) argue for a distinction between “closed” and “open” boundary objects. Closed objects are seen as important but stable representations of expert knowledge across existing and well-defined boundaries of expertise, and open objects are seen as supporting dialogue and the further development of knowledge by allowing for the evolution of representations. It is the incomplete and open-ended character of such objects—posing questions rather than providing solutions—that allows groups to continuously “stabilize some aspects of design and evolve others” (Ewenstein and Whyte 2009, p. 26).

This notion of openness is particularly relevant to the possible role played by nonartefactual objects such as concepts, or in our present study, vision, in supporting collaboration (Star and Griesemer 1989, Star 2010). Winter and Butler (2011, p. 103), for example, highlight the value of the concept of “grand challenges” for work in the field of human genome mapping, where there is a “difficulty of sustaining initiatives over a long time frame.” Similarly, Allhutter and Hofmann (2010) highlight the establishment of the multilayered concept of “quality” as a boundary object in software development. This contrast between the roles played by open and closed boundary objects, respectively,

can also be related to Star's distinction between the "ill-structured" use of boundary objects *between* social worlds and more specific "tailored uses" *within* those worlds (Star 2010).

3.2. Vision and the Framing of Use

The term vision resonates with previous work in the IS field and beyond, where it has often been used in a portemanteau way to denote the broad intentions and conceptualizations relevant to the early stages of engineering and systems design (Carroll 1995, Jarke and Pohl 1993). In Bechky's (2003) study, for example, there is a description of the "conceptual work" undertaken by engineers designing machines, which involved "envisioning in their heads, on computer screens, and on paper, the machine-to-be" (p. 317). It has also been used, in the sense of "organizing vision," to describe the discursive framing that helps to mobilize the spread of IS innovations at industry level (Swanson and Ramiller 1997). Although the use of the term in the games development sector can certainly be related to this work, it is also distinctive inasmuch as it is more explicitly attached to what Levina (2005) terms "envisioned use" (p. 113), and specifically the problem of developing a shared interpretation of such use. In this respect, it bears a resemblance to work on "technology frames" (Orlikowski and Gash 1994) where frame refers to expectations, beliefs, and assumptions regarding the use and users of a particular technology (Orlikowski and Gash 1994, Davidson 2002). It is not clear, though, how far the role played by vision in games development can be equated with the effect of frames: vision being presented as a more explicit and shared understanding of design and use, whereas the notion of frames highlights the plurality and incongruence of assumptions and interests that different groups bring to technology.

3.3. Theoretical Framework and Research Questions

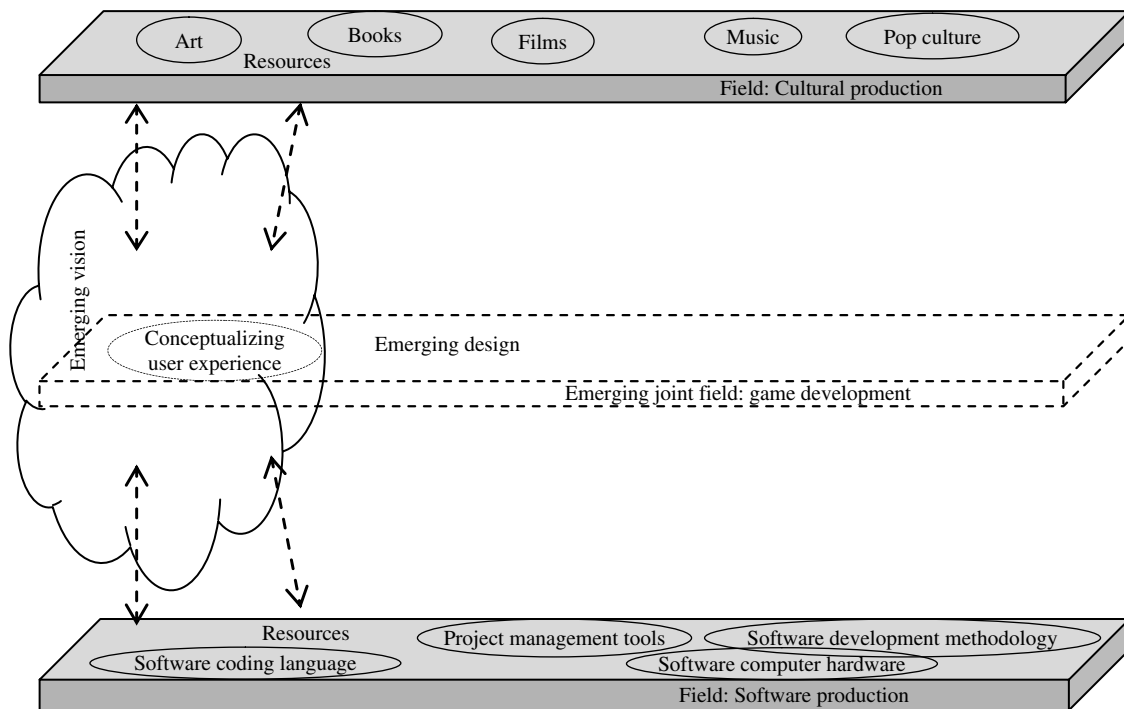
Our review of relevant literature highlights the distinctive collaborative challenges confronting games developers as they seek to integrate their conceptualization of the user experience within the practices of games development. It is apparent from existing work that these challenges are not primarily attributable to the shared problems that arise at the boundaries of different well-defined groups' expertise. We argue, therefore, that the attention that has previously been given to "knowledge boundaries" between expert groups needs to be complemented by a wider focus, not only on the practices enacted by those groups, but also on what Bourdieu terms the "fields" in which those practices are produced, and the resources that those fields make available (Bourdieu 1990, Bourdieu

and Johnson 1993, Hesmondhalgh 2006). The notion of field, which can be broadly equated with the above noted concept of "social world" (Star and Griesemer 1989), refers to the semiautonomous and distinct arenas within which social activity takes place. The boundaries of fields are seen as variable and dynamic, and fields may be wide ranging such as a professional group, or highly specific such as a laboratory. Actors' capacities are then seen as reflecting their positioning within particular fields, acknowledging that groups may be simultaneously positioned within multiple fields (Bourdieu 1990).

Adopting this wider focus on fields encourages us to view the collaborative challenges in computer games development not simply as a product of knowledge boundaries between different developer groups, but also as a consequence of the multiple and disparate fields in which this work is situated. As noted earlier, the computer games setting is distinctive in the way in which wider cultural resources are deployed within software development in order to achieve a novel user experience. Although complex work processes invariably encompass multiple boundaries and expert domains, certain boundaries are seen to become more salient as groups seek to collaborate, whereas others are de-emphasized and decay (Majchrzak et al. 2011, Barrett et al. 2012). In this respect, the field boundaries that emerge as most salient in an analysis of games development encompass not only the specific industrial, professional, and organizational fields of the computer games setting itself, but also the wider cultural field in which groups of developers are (differentially) positioned. The salience of these field boundaries for collaboration is underlined by sector studies that emphasize the tensions between industrial norms and practices, on one hand, and creative or culturally oriented norms and practices on the other (Green et al. 2007, Potts et al. 2008). Tschang, for example, describes this as a tension between rationalization and creativity in the sector (Tschang 2007). Particularly relevant to games development is the deployment of a wide range of resources and shared understandings available in what Bourdieu terms the field of "cultural production" (Bourdieu and Johnson 1993, Hesmondhalgh 2006), including pop culture resources such as TV programmes, movies, and comic books (Aoyama and Izushi 2003).

The value of highlighting these different fields is that it enables our analysis to encompass both the distributed forms of expertise found within the industrial setting of games production, and the wider field of cultural production from which resources are applied to developing the experiential dimension of use. In adopting this focus in our study, we seek to build on previous work that relates new practices in

Figure 1 Theoretical Framework: Development of a Specific Joint Field Centred on Game Development



the design and use of technology to actors' ability to span different fields, and, ultimately to develop a new joint field (Levina and Vaast 2005). This leads us to view the computer games sector as straddling the disparate fields of software production and cultural production, with each new game project entailing the further cultivation of an emerging joint field of practice (Figure 1). The identification here of the most salient fields, and the emerging vision as an important boundary object, draws on our previous discussion of computer games development, and thus expresses not only our particular analytical concerns, but also theoretical concerns highlighted by previous work.

As outlined in Figure 1, games development is seen as involving groups positioned within and across the broad fields of software and cultural production (top and bottom layers) coming together to develop a specific joint field (middle layer) that emerges further through the development of particular game offerings. It thus serves as an initial theoretical framework to guide our conceptual development, and enables us to relate the collaborative challenges and mechanisms described previously to the creation of new joint fields. In particular, it offers an integrated and dynamic understanding of the role played by boundary objects in supporting collaboration by studying the importance of vision in this setting. Thus, where previous work has linked the role of boundary objects to existing well-defined divisions in expertise, our framework helps to make sense of their more open or dynamic role by relating them to emergent design

based on conceptualizations of user experience and the establishment of new joint fields. This framework helps to orient our theoretical concern with the role played by vision in conceptualizing the user experience by focusing on the need to access, select, and exploit the resources available in different fields.

In exploring this theoretical framework through our empirical study, we posed the following research questions: (a) How do the collaborative practices across expert groups overcome the challenges of realizing a desired, culturally rich, and immersive user experience? (b) How are boundary objects deployed to support such collaboration and what role do they play in spanning different fields?; and (c) What role does vision play in enabling groups to collaborate in the conceptualization of a game's design?

4. Research Approach

The empirical focus of the research is the collaborative practices encountered at three different computer game studios as developers go about realizing their novel software products. Through a broadly interpretive approach (Orlikowski and Baroudi 1991, Walsham 1995), the empirical investigation sought to gain a detailed view of the work practices of game developers and their associated boundary objects.

4.1. Empirical Setting

The study was conducted in three leading UK-based computer game developer studios: Quipp, Petname, and Dredd (pseudonyms). Quipp is a leading

independently owned multiplatform and multigenre developer founded in 1990. Petname is a commercially successful and critically acclaimed games development company founded in 1997 and now owned by a major global software corporation. Dredd is an independently owned multiplatform and multigenre game developer established in 1992. The average number of long-term full-time employees at all of the three studios was around 250. Games under development at all three studios included both original titles and sequels. Table 1 provides a summary of the context and data collection at these three research sites.

Although we acknowledge the different organizational settings for the developer groups in our study, the focus of our research and the selection of sites is not motivated by a comparative logic, but rather an interest in identifying commonalities in the development process and associated practices across sites (Langley 1999, Monteiro et al. 2012). This reflects our theoretical interest in the wider fields in which the practices and social formation of games developers emerge and that transcend (but are manifested within) the organizational arrangements of particular firms (Monteiro et al. 2012). Given this theoretical interest, our primary concern was the way in which collaborating teams addressed broadly similar challenges across sites (Majchrzak et al. 2011). The inclusion of multiple settings also serves to ensure that our findings are grounded in varying empirical evidence (Eisenhardt and Graebner 2007).

4.2. Data Collection

Data collection involved a combination of in-depth and targeted semistructured interviews and observations undertaken between September 2008 and August 2009, primarily at the three computer games studios, but also at associated organizations (e.g., games project commissioners, game engine technology suppliers). Some follow-up interviews took place after the main phase of empirical material collection (between September 2009–January 2010), usually in relation to the clarification of certain areas of interest that emerged as the material collected was processed. The extended fieldwork period reflected the need to accommodate the scheduling pressures and delays at the three studios in relation to project lifecycles and deadlines.

In addition to interviews and observations, the empirical material collected included key objects involved in the development of computer games. Twenty-five interviews and 60 hours of observations were carried out with developers and managers at these companies. To provide a cross-sectional view of the game development groups involved in the work process, our sample of interviewees

ranged across different levels of management, such as development managers, commissioners, heads of design and programming, as well as different functional groups such as games engine, weapons, and animation, and different levels of technical expertise such as team leaders and team members. Interviews were carried out both in management offices and the games development workspace.

In-depth interviews (between 1 hour 40 minutes and 3 hours) were voice recorded and transcribed (Table 1), and addressed headline themes regarding the overall process of games development and how it was organized and performed. Targeted interviews (from 10 to 20 minutes) were used for more specific questions relating to key aspects of the development process that emerged during the observations. These were recorded in handwritten notes to capture, in the moment, an explanation from those involved in particular collaborative activities. Interviews were supplemented by informal conversations with team members during the day-to-day conduct of their work. Observational material was recorded primarily in note form, usually during or soon after a certain event or encounter. This included intensive observation of one of the development teams at Petname over a continuous period of two weeks. During this period, the researcher participated in a number of formal and ad hoc project meetings and observed developers as they worked or discussed problems and game features among themselves.

The collection and studying of key objects/documents sought to reflect the material dimension of our research focus, and to reduce the reliance on interviews (Orlikowski and Baroudi 1991). The objects involved in the design and development of the game studied can be found in Table 1.

4.3. Data Analysis

Informed by our practice-based approach (Carlile 2002, Levina and Vaast 2005, Schatzki et al. 2001) and a view of practices as “a theoretically-grounded understanding of the recursive interaction among people, activities, artifacts, and contexts” (Orlikowski 2010, p. 26), the fieldwork material from the three sites was coded in relation to the recurrence over time from project to project and across sites.

In the first instance, interview transcripts, observation notes, and other material (e.g., training documentation) were coded to identify and highlight extracts relating to occurrences of collaboration. Using nVivo, this coding process helped to display all the extracts of text identified as referring to collaboration. Our analysis then focussed on those specific passages and sought to code them in terms of the individuals and objects involved (already defined in nVivo) as well as by the aim of the collaboration (e.g., to produce a

Table 1 Empirical Setting and Summary of Data Collection

Pseudonyms	Quipp	Petname	Dredd
Organization	Five divisions: family games, mature titles, serious games, downloadable games, and games technology with dedicated teams supported by company-wide functions.	Studio organized around dedicated teams that work exclusively on a series of specific titles with the aim of establishing durable and recurring franchises.	“Superstudio” structure where specialist teams work across a number of titles simultaneously.
Types of games	Multiplatform and multigenre developer of own brands games and on behalf of external publishers and IP rights holders.	Single platform commercially successful, critically acclaimed, and award-winning strategy, action role playing, and simulation games.	Multiplatform and multigenre developer of own brand and third-party games that has enjoyed significant commercial success.
Empirical data	Nine interviews (approximately 5 h [3 h 40 min in-depth; one h 20 min targeted]); eight conversations, two follow-up interviews and emails (Sep. 2009–Jan. 2010). 14 hours of observation 350 pages of documentation.	14 interviews (approximately 10 h [five h 15 min in-depth; 4 h 45 min targeted]); 40 conversations. 35 hours of observation 500 pages of documentation one h of video diaries.	Three interviews (approximately 4 h 30 min [3 h 45 min in-depth; 45 min targeted]); five conversations, one follow-up interview and email exchanges (Sep. 2009–Jan. 2010). 11 hours of observation 70 pages of documentation.
Study of people/processes	In-depth interviews with director of development × 2, director of business development × 2; conversations and targeted interviews with downloadable games (three people) and serious games (two people) teams, predevelopment team members (three people); conversations around issues of collaboration with diverse team members from across the five divisions.	In-depth interviews each with executive producer × 2, development manager × 3; targeted interviews: head of production, head of programming, head of design, chief of design production, weapons programmer, weapons artist; physics engine specialist; programming production coordinator, art production coordinator, digital assets processor; participant observation of a development team, attending project related meetings, and informal discussions/conversations.	In-depth interviews with senior producer × 2, development manager; conversations and targeted interviews with and observations of specialist teams. (Because of the superstudio structure, specialist teams worked across a number of games projects at the same time. As a result, the interactions with the teams was very much in relation to illuminating specific issues that came up in the interviews with the two senior staff.)
Gathering and studying of objects/documents and other materials	Documentation relating to the training of new developer recruits across the various function areas (art, design, programming, animation, production) and how to work with specifications and in relation to other specializations, the development of reusable multimedia objects assets, five concept books, extracts from game design documents.	Photographs (taken by the researchers) of developers working, work environment and whiteboards use, video diaries (by developers) of their work/ contribution, videos produced for use in the game being developed, other objects (screen shots) of extracts from game design documents from two games, milestone schedule for project observed, object/asset tracking database, project calendar, access to internal wikis, blogs, and online discussion forums.	Viewed extracts from game design document and early-stage conceptualizations of a game; diagrams and sketches drawn on flip chart and in notebooks by developers (also copied by research from whiteboards) during meetings depicting particular stages in the development process and their view of them. Screen grabs relating to specific issues/game features raised in the interviews.

finished asset, or arrange assets in the game world). “Aims” were seen as the “outcomes” of the collaboration involving individuals and objects along the design path and considered as “an ongoing process of moving an object from its current state to a required end state.” (Carlile 2002, p. 446). Because of their association with studios through nVivo, it was also possible to see which of these accounts of collaboration were present across all three sites and thus to further narrow down the material by excluding only local forms of collaboration. Through the descriptive coding based on aims, it was also possible to go back to the definition of the objects in nVivo and add further attributes in terms of their role in the collaboration and the bound-

aries they were associated with. Through this coding we were able to assemble from the raw empirical descriptions, and based on the entities identified (individuals and objects) and how they related to each other, a series of stylized, composite overviews of collaboration, which were centred on a particular aim. Appendix B is an illustrative example of such a stylized account of collaboration around the aim of developing a milestone schedule. Such a stylized overview is not only appropriate to the analysis of process data (Langley 1999), but also helps to encompass both “the conditions of the local accomplishment of practice, and the ways in which practices are associated into broad

textures to form the landscape of our daily (organizational) life” (Nicolini 2009, p. 1392).

The next stage of coding focussed on the identification of first-order categories based on the aims of all the assembled stylised overviews of collaboration and the boundaries spanned in them. In the final stage of coding, we clustered the categories based on common aims into higher-order themes or “practices” (Appendix A). We were able to identify and describe six major groupings of collaborative practices. Assembling, representing, and arranging (which we named “producing practices”) emerged as practices associated with the production of the game and focussed on the development and ordering of digital assets. The other three practices identified—surfacing, capturing, and formalizing (which we named “envisioning practices”)—were more concerned with articulating the user experience to be attained through that software. Appendix A summarizes the key stages of coding and analysis: (a) coding on extracts relating to occurrences of collaboration (samples of targeted-interview notes from Petname, in-depth interview transcript from Dredd, and observation notes from Quipp); (b) assembling a series of stylized composite versions of the collaboration with particular aims (an example in Appendix B); and (c) identification of related first-order categories and second-order themes.

5. Empirical Findings

In this section we focus on analysing the collaborative practices identified in our empirical study. Guided by our theoretical framework (Figure 1), we sought to identify the collaborative practices that emerged to span both the boundaries of expert groups and the different fields encompassed by games development. We first provide a brief outline of some of the established practices of game production seen in our empirical study, introducing key terms used in the games sector as well as the complex interactions between the groups involved in the development process. Then, motivated by our research questions, we focus in more detail on the practices through which the conceptualization of the user experience was articulated and eventually integrated within software production.

5.1. Games Development in Context

Whereas all three studios displayed some differences in the organization of work, as noted in Table 1, they also shared a number of important characteristics, which seemed to reflect the norms and practices within the computer games sector. Thus, all of these organizational settings were characterized by similar workspaces in which aesthetic and culturally laden artefacts, including artwork, pictures from magazines, and physical models, commingled with

the high technology computing apparatus of software production. Although these workspaces were all open plan, individuals were typically clustered in work group areas. The social environment was informal, but also highly pressurized as is typical of project and innovation-oriented organizations (Kellogg et al. 2006). Alongside these similarities in the work process, there were also organization-specific differences. Thus, in two of the studios (Petname, Quipp) core teams of individuals were assigned full time to specific projects and moved to other projects only on completion. Dredd, on the other hand was organized around a “superstudio” structure where specialist teams worked across a number of titles simultaneously.

Despite these variations in project arrangements, in all three studios work groups were structured along the same broad disciplinary lines of “art,” “design,” “programming,” and “production,” allowing for some variation in terms of the prominence given to new, hybrid disciplines such as “animation.” The boundaries of these expert groups were also broadly similar. Hence, art teams were responsible for the production of many of the 2D and 3D digital art objects (characters and environment) making up the game world; design teams for the design and formal specification of the game world and the conceptualization of the action within in it; programming team members for the writing of computer code needed in the game, ranging from artificial intelligence algorithms to development tools, and also for developing user interfaces and functionalities for the “game engine”; and production teams managed the production process, from project planning and management to organizing the workflow and resolving cross-discipline cooperation issues. Each of these groups was headed by a manager (e.g., head of programming, head of art) and a senior specialist (e.g., lead programmer or a lead artist).

In our study we found that the expertise represented by these groups was subject to divergent pressures, with, on the one hand, new roles emerging as a result of a drive toward greater specialization, but, at the same time, a blurring of existing disciplines due to the pressures of project-based collaboration. New specialized groups were emerging such as “riggers” who had secured a role within the animation area to develop the “skeletons” of characters, and “technical artists” whose role involved combining skills in both art and programming. At the same time, although this description of occupational groupings bears witness to the range and specialization of expertise involved in games development, it does not map onto the highly flexible, cross-disciplinary and task-oriented way in which individuals and groups actually worked.

The development process itself was structured in a similar fashion across all three sites. In simple descriptive terms, we can say that initial ideas for a new game, either from game developers themselves or from games publishers, were the starting point. The idea would be further developed by the game designers working in collaboration with other developers (e.g., from art or technology) by producing narrative and visual representations. Over time, the idea would be iteratively refined into a more detailed documentary form, including an overarching “concept book” for the game, and associated game design document (GDD) and the art and technical design documents.

The concept book was a key shared object because it related the conceptualization of the game to the specification of game features to be pursued collaboratively. A Petname development manager described this object as follows:

It has pictures and varied descriptions of the story and plots and who the main characters are, biographies of who these people are, what they look like; it covers all aspects of the game. It is usually a 70 to 80-page document which encapsulates what the game is going to be—what we intend it to be, anyway—and tries to cover all the risks, all the areas we are going to have to look at, the story, the core technologies,...even a budget section at the end, the staff plan, with the end date, the start date and the phases and all the markers in between. It tries, at a high level, [to] encapsulate the whole game, how long it's going to take, and what it's going to be.

Examination of a number of concept books revealed that these were professionally produced and aesthetically engaging documents, each one styled in accordance with the theme of the proposed game. For example, the concept book for a science fiction game had covers made out of shiny metal, shaped and indented to look like a spaceship door. These and other documents would guide the use of development tools and software applications in producing the digital assets that represent the different components of the game, including digital artwork, 3D models, maps of levels and locations, animation sequences, visual textures, special effects, and sounds and spoken dialogues. These are assembled to produce the whole “game world” with multiple levels, characters, and gameplay possibilities. The assets making up this world are then translated into executable code by the “game engine,” that is, the software that interacts with the hardware of the target game platform (e.g., game console, PC).

5.2. Collaborative Practices in Games Development

A significant strand of collaborative activity at all three studios involved individuals working across as

well as within specialist groups. In analyzing this activity, we identified six major groupings of practices that emerged (Appendix A) as the games were developed. These practices are categorized and presented analytically in Table 2, but it is important to recognize that they unfolded in a nonlinear and highly interdependent way in each of our case settings.

5.2.1. Producing Practices. Certain practices, namely, assembling, representing, and arranging were primarily concerned with the production of the games software and centred on the development and ordering of digital assets. These collaborative practices, which we have called “producing practices,” relied heavily on key shared objects, including the GDD, the art and technical design documents, and the concept book. Each practice is described in more detail as follows:

Representing. the leads of the different disciplines involved in a project sought to represent the deliverables required from the different expert groups within the above-noted document formats and in a form that was commonly understood across those groups. These specifications were invariably viewed as provisional, and would be iteratively altered and expanded as the game took shape and became more representable in documents.

Assembling. this involved producing and storing at specified server locations the digital assets specified by a game's documentation (GDD etc.) with specific file formats, metadata tags, and file naming conventions.

Arranging. this involved the use of a “game editor” to place specific assembled assets from a shared server into the designated location in the game world (the latter being defined by pre-existing assets in the “build version” of the game). This was seldom a straightforward activity or the remit of specialist level editors alone, but typically involved significant collaboration across groups. For example, “level editors” and “level designers” collaborated with programmers and art specialists in order to deal with the technical limitations of the level being assembled, how to implement new gameplay features, or more detailed questions on the size and presentation of assets.

5.2.2. Envisioning Practices. Other practices identified in our analysis, termed “envisioning practices,” were concerned less with the production of the game software than with conceptualizing and realizing the desired user experience to be attained through that software. Management at all three studios emphasized the tension between the rationalizing pressures of delivering a product to specification and on time, and the need to be innovative and creative in the user experience that it enabled. Bob (a pseudonym, as with

Table 2 Summary of Collaborative Practices Identified

Collaboration identified	Boundary spanning	Aims	Practices
Conceptualization, development, and scheduling of formal specifications of product features and components that leverage the formal knowledge of the developers (e.g., dimensions, scale, interfacing, format, file naming, use of game hardware resources).	Expertise of specialists in business development, marketing, business analysis, project planning, desktop publishing, writing and editing text and that of lead developers from the art, design, and programming teams made combinable and brought together through text, drawings, photographs, tables, and spreadsheets.	Production of representations of the game and its components to provide developers with the necessary information to understand how the assets and inputs they must contribute should be.	Representing
Developers with different types of expertise (level editors, environmental art specialists, character art specialists, animators, artificial intelligence programmers) use specifications based on shared syntactic and semantic understandings to schedule, produce, and pass to each other assets.	Environmental and character art specialists, animators, special effects specialists, GUI specialists, artificial intelligence specialists, tool and game engine specialists use the technical and other formal specifications and their specialist knowledge and skills to build, exchange, bring together and make available to each other assets and other specified components for the game.	Identification of existing assets and production of new assets to be brought together and made available at a specific point in the process for use in the game.	Assembling
Through the following of the specifications the assets and other inputs developed have to be arranged together with as few major problems in terms of operational functioning as possible. Problem solving mainly framed in terms of misalignments due to misinterpretations of syntactic and semantic information or missing of schedule.	Level editors and designers use documentation and direct interactions with those producing assets to identify, judge, locate on shared servers, and place in the game assets and other inputs for a particular level made available by the specialists in accordance with the schedule and specifications.	Relational and temporal ordering and fitting together of assets at the technical and operational level to make up the game.	Arranging
Concept art and visual and other external references used to evoke in developers the desired usage of the game as per the emerging vision for in which developers then express in the initial versions of assets or through nonformal representations of inputs required from them.	Concept artists and lead designers provide some initial “cues” rather than specifications in the documentation and an initial articulation of the vision, but the “fleshing-out” of experiential dimensions among those detailed to produce inputs takes pace through their collaboration drawing often on resources from outside the field of games development (books, movies, TV, external references etc.).	Evoke in fellow developers experiential dimensions of the game through cues rather than specifications that then get expressed in material outputs.	Surfacing
Commenting and debating on concrete outputs expressing the required emerging vision. Through the commenting and resulting revising both the components of the game and the overall vision take shape and become more explicit, informing the collective and individual understandings of the developers for further referencing in the development process.	Commenting and debating on the game or a level as a whole mostly outside areas of specialist expertise but much more along the lines of whether the output generated “fits” with the overall vision for the game, the aimed-for playing experience, the “intention” of the game, the aimed for “atmosphere,” and so on.	Make use dimensions expressed through individual assets, shareable among the development teams so that new fragments of the emerging vision become accessible at a collective level.	Capturing
Integrating emergent outputs and their development into the overall workflow of the development process and associating with the resources and time allocated for their realization. In the process, ways of expressing these features using either existing formal specifications and representations or developing new ones are arrived at.	Project coordinators together with senior members of the multiexpertise teams working on the relevant part of the game first seek to describe what is needed to achieve the desired playing experience using text. From that text formal domain expertise will be drawn on to define, specify, schedule concrete deliverables using the established representations of the studio, either “as is” or through adaptation.	Integrate informal collective understandings of the game-playing experience into the formal aspects and representations of the development process.	Formalizing

all the names used in this section), a senior producer at Dredd, commented forcefully:

I’ve got all this paper interaction going on. I’ve got strike teams there. I’ve got people getting deadlines. I’ve got people defining their deadlines to me. I’ve got a waterfall schedule. I’ve got an idea of how many people it’s going to take to make the game. I’ve got an idea of how risky and how complex it’s going

to be. ...[But], it’s not just all about planning. These guys make tangible assets, [but also], they create an experience on a screen; and that’s what it’s all about. I provide a beautiful plan, but that’s not going to mean anything to Joe Schmoe, who goes out and buys a game on the shelves.

Desired dimensions of the user experience typically included self-consistency in the overall “look” and

“atmosphere” of a level, the timing and choreography of the action, and the overall experience of the gameplay. Conceptualizing the user experience, however, created many challenges for collaboration. These challenges were partly a consequence of the interactive and culturally mediated character of gameplay, but also reflected the need to be innovative in a highly competitive marketplace. To address these challenges, managers and developers at all three sites referenced the distinctive vision for each game under development as an important focus for collaboration. The vision was seen as being reflected but not fully represented in the documentation for the game, such as the concept book or the game design document. Rather, the vision was an evolving conceptualization, which transcended particular representations. As Vic, the development director at Quipp, observed, the vision helped to convey multiple aspects of the game; “This is the kind of game we are creating; this is the kind of mood we want to create for the player; this is the kind of visual feeling we want to create and the visual feedback we want to create; these are the kind of technical limitations we want to break... .” It was not, however, fixed, but was expected to change. As Vic explained

...although the vision will probably change massively during time, as long as at the end (...) you have a pretty much coherent vision nailed, whether it is the same one you started with doesn't really matter; as long as it is something that everyone has agreed with and everyone is happy to do and follow through during production.

As this quote indicates, the collaborative practices of different groups were seen as highly dependent on the vision being collectively shared. Bob, the senior production executive at Dredd explained this need as follows:

Generally, the more you fragment [the vision], the more difficult it is to keep your entire team understanding what it is you're trying to create. As soon as you've got that fragmentation...you'll get cracks; you'll get mistakes; you'll get misunderstanding; and you'll get delays and frustration.

We found that in practice the required coherence of the vision was achieved by the development and sharing of a heterogeneous range of incomplete or fragmentary representations—e.g., artwork, cartoons, movie dialogue. These helped to articulate the vision as an emerging collective interpretation of what the game should be. At the same time, the vision was constituted, shared, and sustained through a distinct set of collaborative practices. These “envisioning practices” we identified as follows:

Surfacing refers to collaboration in which fragmentary representations are used as cues to indirectly evoke the desired user experience, stimulating developers to create an initial material output. Responses

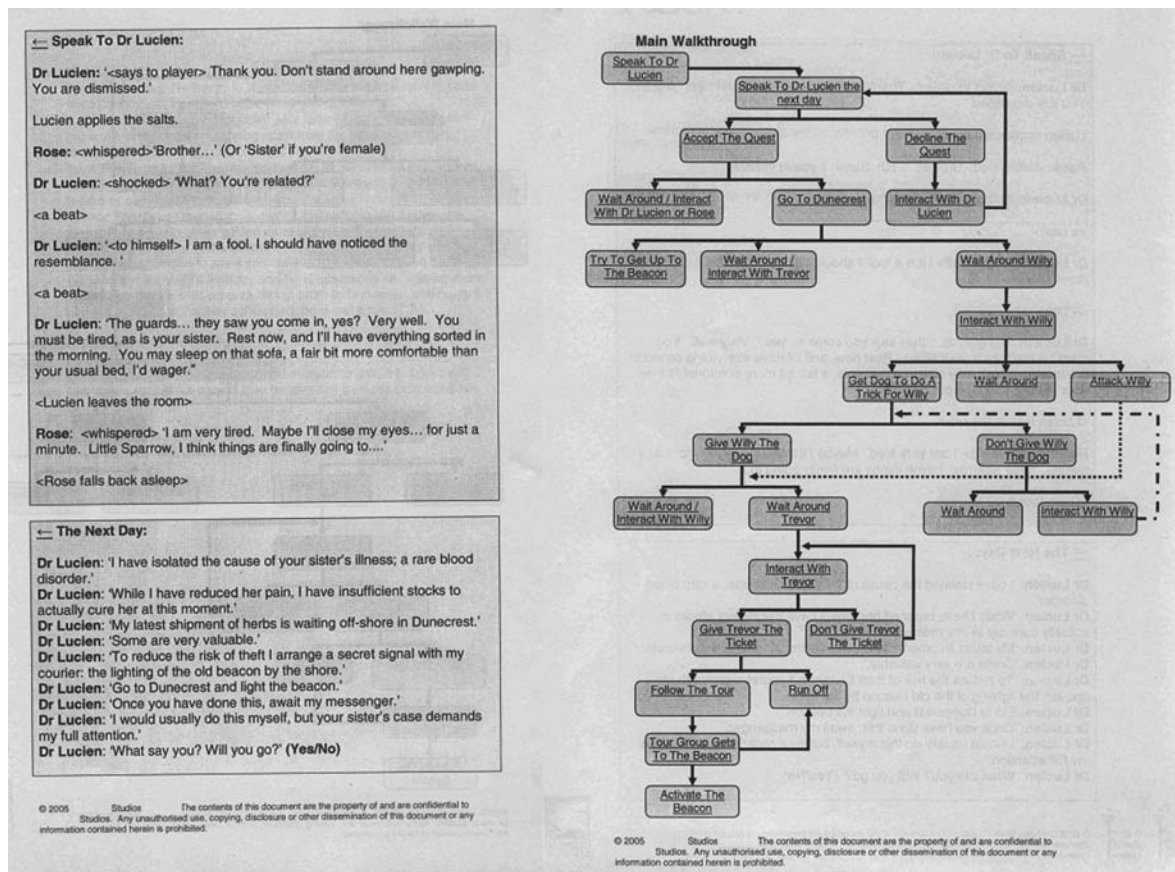
to the vision could thus be externalized in the form of a material output, such as an early version of an asset. A number of objects were involved in this practice, ranging from concept drawings to other visual references and models. External references such as movies, cartoons, or other games were seen as particularly useful in fostering a shared interpretation of what was intended regarding the “emotion” or “visual style” of the game. These objects helped to give greater shape to the vision, and helped developers to access a wider range of cultural resources.

An example of this practice was observed in the interaction at Petname between Chris, a modeller and Kelvin, a weapons programmer, who were working to develop the weapons to be used in a new game. Their initial interaction reflected their differences in expertise. Chris was preoccupied with matching the weapons as closely as possible to the concept art and the specification in the GDD and art design document. In contrast, Kelvin was concerned with achieving greater efficiency in the use of “polygons,” and scalability of the assets. As the two worked together on implementing these ideas and trying out the resulting assets, their expert concerns were overtaken by a shared realization that the weapons they had produced “felt too contemporary.” To reflect the vision for the game (described as “set in the times of the highwayman”), they agreed to sacrifice some efficiency by making the weapons “more like muskets.” From this simple example it is possible to see how the interplay between an incomplete representation of the vision—in the times of the highway man—and the initial material outputs, helped these developers to collaboratively articulate, without recourse to a given specification, a more detailed interpretation of how the vision translated into specific game features; something that other project members could subsequently draw on.

Another example of this practice from Petname was when the developers were struggling to realize the drama of certain scenes in a new game. Initially, they attempted to do this through a “game script,” a document that is part of the overall GDD and akin to a decision tree that describes all the possible interactions and possible outcomes for the characters in a scene (see Figure 2).

When this was found to be inadequate, they wrote a “proper movie script.” This was subsequently developed with a professional scriptwriter and actors, and then filmed as a series of short movies. The intention here was not to replicate the movie scenes, but to use the techniques to help better dramatize the scenes in the game itself. Thus, the surfacing practice here involved giving greater coherence to the vision through the use of fragmentary representations

Figure 2 Example of Game Script



(i.e., the short movies), and in the process accessing resources from the wider field of cultural production.

As the above examples show, visualizing and acting out game features was an important part of the surfacing practice, and often drew on resources beyond the scope of formal games documentation. One reflection of the importance of such resources, was the widespread use of models in the development process (ranging from miniature mock-ups of landscapes, to small sculpted figures, as shown in (Figure 4) and the intensive creation (typically by art and design teams) and shared use of concept art (Figure 3)) Caroline, the executive producer at Petname explains the role of such artwork as follows:

The more ways that we can do that—communicate exactly what you want [and] for everyone to get and understand it—[the better]. It is like the Holy Grail; because everyone understands differently. If you go visual that helps immensely. . . .

Likewise, the following comment from Vic indicates a similar use of concept art at Quipp: “We try and draw a huge amount of stuff during the project because the cheapest way of getting any visualisations is by drawing . . .”

External resources were also widely utilized in order to convey the “mood” or “atmosphere” for a

level, quest, or scene. Such references could be used to guide developers toward, or away from, the vision. As Vic at Quipp commented,

With everything we have created, even if it is “true to original” there is always a movie, or a book in some cases, or another game possibly, that have done something similar or have done something diametrically opposite that we can say: “this is really what we don’t want, we really don’t want this vision.” Or, “what I am trying to get to is this,” or “here is a movie.” . . . Using those . . . references . . . people come up with ideas and come up with visual styles [and] that’s how [the vision] works; it kind of trickles down.

One example here is the development of a role-playing game at Petname that involved the depiction of a proto-industrial world. In a first iteration, external references from picture archives were used to inform the development of environment and characters, but developers felt “that something was missing” and that the region lacked the desired “dark satanic mills”¹ feel. This led one of the developers involved to

¹ He is referring to the widely known (in the UK) church hymn *Jerusalem* in which the term “dark satanic mills” is associated with the destruction of nature and human relationships in the early Industrial Revolution in Britain.

Figure 3 Character, Environment, and Object (Swords in the Middle of Picture on the Right) Concept Art at Petname

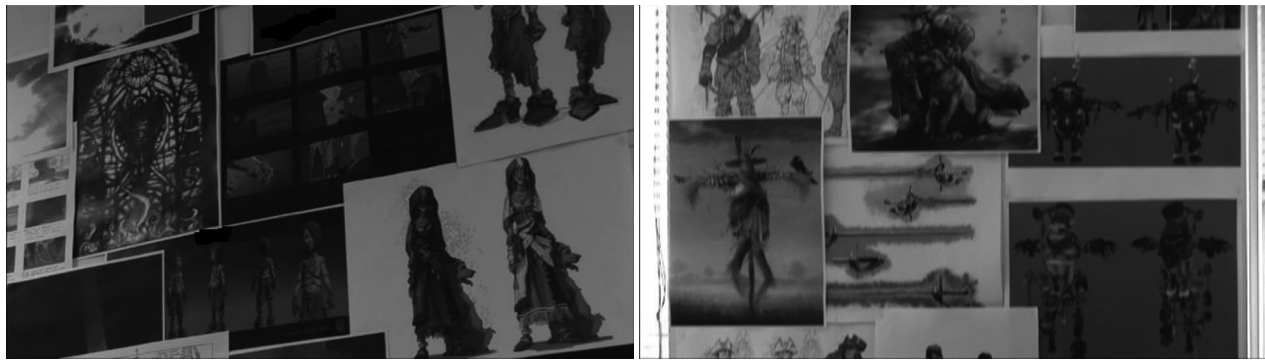
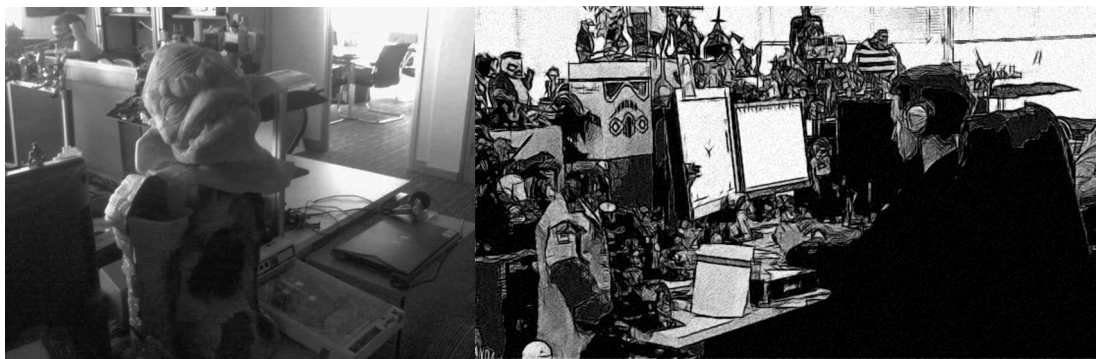


Figure 4 Models and Other 3D Visual References at One of the Studios Studied, and Visually Intense Workspace Populated with Models and Visual Cues and References at One of the Studios Studied



circulate a copy of *"The condition of the working class in England"* (Engels and McLellan 2009), which he was reading at the time, and which helped developers better understand how the world should "feel."

The practice of *capturing* refers to further articulating the vision—or specific parts of it—and making it shareable among wider developer teams. This often involved a collective commenting on the initial expression of the vision as conveyed in some preliminary outputs. The term "commenting" is preferred here because this was not simply a dialogue among participants, but was oriented toward objects and/or ensembles of objects, such as an action scene in a game (see Figure 5 for a depiction of developers commenting on such a scene as they watch it unfold). Through this practice, the developers both contributed to, and drew from, an emerging interpretation of the vision for the game.

The practice of *capturing* was an important feature of milestone review and other meetings that brought different disciplines together. During one such meeting at Petname, as the game designers presented new on-screen walk throughs of levels and quests, there was an intensive dialogue across groups that included vocal disapproval of some features and antagonistic questioning. Significantly, the developers' comments were not confined to their own part of the game, but

referenced the game as a whole. In this way, the interpretation of the vision was effectively collectivized. The importance of such commenting, critique, and contestation is expressed in the following observation from Vic at Quipp:

When work starts getting developed, like character scenarios or storylines or character designs or weapons, we can look at those...and go: "this really doesn't fit...can we revise it," or "do we have to junk it, or what?" By going through that process and learning, and by saying: "yes, *I get it*, current design doesn't fit because it's got the wrong kind of proportions," or, "the wrong colour skin," or whatever

Figure 5 Collective Commenting on an Early Version of a Combat Scene



it might be, and then learn from that and [go], “OK, sorry about that I didn’t realise, I’ll revise and redo.”

As Vic emphasized moreover, this kind of capturing involved a holistic appraisal: “At that point you are really looking at the game as a whole. (...)...something like: ‘it crashes here,’ or ‘this doesn’t do what we said it should do,’ (...) but we are looking at it as a whole now. Really as the whole experience... ”

The practice of *formalizing* involved integrating the shared interpretations arrived at through the practices of *surfacing* and *capturing* into the more formally organized parts of the development process. This can be illustrated by the above example of the Petname milestone review meeting. Here, senior members of the production team wrote notes on the agreed addressing of the contested points in the meeting, and subsequently translated their implications for the vision and game design into the revision of existing objects such as the GDD and the art and technology design documents. Briefly, this involved defining the revisions as a concrete deliverable and associating it with a completion date, a signing-off procedure, and an “owner” from within the development team responsible for its delivery. This aspect of the collaboration is crucial because it is the point where the emerging vision for the game is given material expression in terms of establishing dependencies with game components, resources, and time. Also, in this way, resources acquired from the wider fields of software and cultural production are transformed into the vocabulary and systems of representation used by the specialist groups involved in the production of games software.

5.3. Integrating Practices in the Games Development Process

The different practices outlined above did not unfold discretely or sequentially within the games development process. To show the interweaving of these practices within that process, in this section we outline three vignettes drawn from our fieldwork observations.

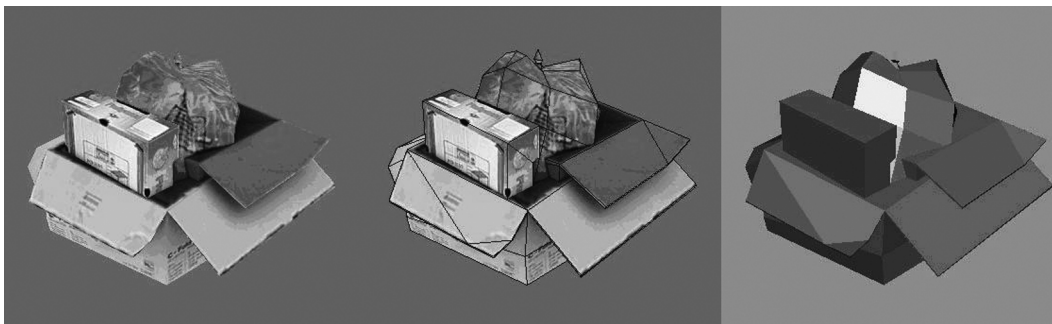
Our *first vignette* illustrates how envisioning and producing practices were integrated in developing

even the most minute features of a game; we present an example from an urban action adventure game at Quipp (Figure 6). Here a heap of garbage in one scene was specified as an asset in the GDD. This involved detailing its purpose and location in the game, its dimensions, and the shapes that make it up (*representing*). These shapes were then drawn and put together in outline using a 3D art software package by a modeller (*arranging*). The various digital surfaces thus generated were then given colour, texture, and styled appropriately through associating them with other lower level assets of those types (*assembling*). The resulting heap of garbage as a composite asset would then also be arranged in the relevant scene of the overall game where it would be encountered during the playing of the game.

Many aspects of this asset could be represented within the scope of existing specialist expertise, such that leads from design, art, and programming could specify, for example, a scale for the asset, a polygon count (the total number of “base” 2D shapes that compose any shape in game), the “lighting” to be used, and the orientation and positioning of the asset in the level. All these specifications were seen as crucial to the problem-free functioning of the finished game. For example, it was very important that the polygon count specified in the GDD for even the most trivial art asset in a scene was respected as cumulative overruns could impact the core operational performance and speed of the game.

Other aspects of the asset, however, were more difficult to represent, but were equally important to the final playing experience. The developers, for example, had to ensure that an asset complied with the aesthetics of both the scene and the game as a whole. In this they drew on the vision for the game, and the shared interpretation of “look and feel” that this engendered. They thus not only had to comply with the polygon count specified, but had to also ensure the right “distribution” of the polygons to avoid making the scene, as one developer put it, “appear too simple or choppy.”

Figure 6 Assembling of a Simple Static Low-Level Environmental “Asset” (Source: Quipp)



Our *second vignette*—the gypsy quest—contributes to our analysis in two ways. It not only shows the possibility of contestation within envisioning practices, but also provides an important example of the way in which user groups were addressed through such practices. In a milestone review meeting at Petname, the design team made a presentation to the other developer groups of a new quest (previously specified within the GDD) involving two conflicting groups, “gypsies” and “renegades.” The projected unfolding of the quest would see the hero facing a choice of betraying the gypsies and switching allegiance to the renegades, or shooting the renegade leader in the face and escaping back to the gypsy village. Caroline, the executive producer asked why the only option should be for the hero to fight the renegades instead of finding a way to reach a mutually acceptable negotiated settlement. The response from the majority of the (predominantly male) developer group was that the users had repeatedly shown their preference for fighting both through market research and user forums. Caroline responded by arguing that although existing users were mainly young men, it was company policy to expand the “franchise” of the title by attracting female users. The latter, she said, would prefer less fighting and more “social” solutions. As the argument continued, however, it moved away from this gender issue to discuss how this scene aligned with the wider vision for the game including character development and possible game outcomes. It was around these concerns, rather than the expectations of user groups, that the argument was eventually resolved, with the design team’s leader conceding that the quest was “unsatisfactory” as it did little to advance the “becoming of the hero”—a key aspect of the vision.

Our *third vignette* illustrates how envisioning practices and a partially defined vision enabled developers at Dredd to access resources from other fields in the process of further articulating the vision for a game. This new game was based on a popular TV cartoon series, *The Simpsons*, and the broad vision for the game was to make the experience of being in the game world as close to that of the TV series as possible, requiring a very particular visual aesthetic. An important issue arose when it was found that translating the 2D cartoon characters into the 3D models used in computer games would require the 3D versions to be radically distorted to achieve the cartoon-like aesthetic. Faced with the possibility of laboriously developing many digital 3D versions of the characters by hand, developers eventually settled on a high risk, but ultimately successful, solution that involved

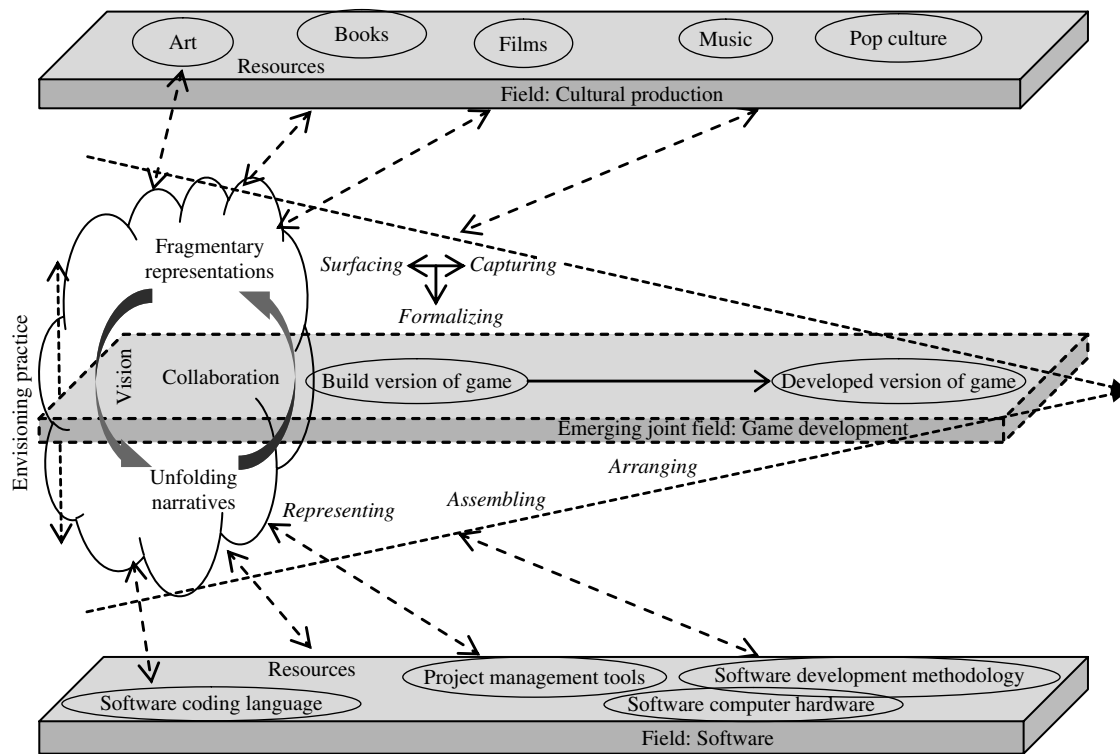
a custom-made software script and using new techniques to introduce the distortion on the fly. Through this example, it is possible to see how the vision here enables the accessing of disparate resources from the fields of cultural and software production (e.g., the demands of pop culture, understanding of TV animation drawing techniques, scripting software) to realize a particular user experience (true-to-original visuals).

5.4. Analytical Overview

In our initial theoretical framework, we characterized the computer games sector as one in which the experiential dimension of game use is a paramount concern. As a result, we argued the sector straddles the fields of both cultural production and software production. Our subsequent analysis of the collaborative practices in this setting shows how the envisioning through which developers seek to address the desired user experience actually involves spanning the practices, norms, and cultural resources that characterize these fields. We differentiated such envisioning practices (surfacing, capturing, and formalizing) analytically from the production practices (representing, assembling, and arranging) that unfolded within the field of game production and that enabled teams to collaborate across boundaries of expertise as they manifested themselves within that field. The relationship between envisioning practices and the emerging vision and their contribution to our initial theoretical framing are depicted in Figure 7.

We found that these envisioning practices enabled team members to effectively bridge the boundaries between disparate fields. Thus, when Kelvin and Chris were engaged in weapons development at Petname, or other groups “commented” on the initial outputs from development in relation to the gypsy quest, their ability to contribute to, and work from, an emerging vision was not bounded by their specialist expertise as manifested in the field of software production. Kelvin and Chris were able to move seamlessly from working *within* their own specialist expertise (weapons artist, weapons programmer) to working *across* fields (i.e., their shared concern to achieve a user experience consistent with the vision), so as to engage with the wider ensemble of game features, such as aesthetics and atmosphere, evoked by their outputs within use. This ability was both supported by, and expressed in, their collaborative practices, but also seems to have derived from personal experience as avid game players. Thus, at Petname and the filmed dramatization of key scenes using actors, the developers commenting on each video “take” did so primarily from the perspective of the game player. This positioning of developers in multiple fields enabled them to work more effectively by drawing on a wider range of cultural resources. This included, for example, parallels with

Figure 7 Conceptualization of Envisioning Practice as a Distinctive Form of Collaboration



the movie industry, such as the use of cinematic techniques to help dramatize scenes, and also the *commenting* observed on what in movie terms would be the “rushes” from initial outputs. As we show also with the use of concept art, the vision for the game helps to translate these wider cultural references into exploitable resources *within* the field of computer games development. In the example above, the vision helps the developers in the identification, selection, and application to their field of computer games development of resources from the field of movie production (camera angles, actors, movie studio, film script, filming techniques) and wider cultural production (different styles and genres of dramatization, dialogue writing style).

In relation to the objects involved in the collaboration, we focused our analysis on how the concept art and other objects used within envisioning practices across all of the studios, helped “evoke” the experiential dimension of use—the look and atmosphere of the game. The role of concept art, for example, was not to provide a blueprint that modellers could reproduce in 3D digital art, but to help establish a broader, collectively shared, interpretation of the required user experience. It did this by guiding teams toward certain cultural but also technical resources and away from others, thus articulating and making more coherent and concrete the emerging vision for the game. This can be seen in the example of the proto-industrial world being developed at Petname where different

objects (concept art, visual references, a hymn, a book) gradually oriented developers to particular internal or external cultural references. The relative importance attached to “evoking” rather than “representing” here points to the dynamic or open character of the vision as a boundary object, and its important role in conceptualizing the experiential dimension of use.

In summary, our empirical section illustrates the interplay between the collaborative practices concerned with realizing the user experience, and those involved in the production of the game software itself, and how objects were involved in this interplay. The next section relates our empirical findings to existing literature and theoretical perspectives to develop a novel understanding of collaborative practices in this distinctive software design and development setting.

6. Discussion and Implications

Relating our analysis to our initial research questions, the primary contribution of our study comes from our analysis of the practices through which the experiential dimension of use is realized within a process of software development. As our study shows, the collaborative practices that help to overcome these challenges are distinctive compared to more conventional, business-oriented forms of software development. Such practices are centred on the problem of conceptualizing the design of games that are intended to be innovative, immersive, and self-consistent, and that incorporate complex, cultural, and affective

features in their playing. To address our research questions, and to better articulate the theoretical and practical contributions of our study to the wider information systems field, we focus our discussion on the implications of these practices for software development practice more generally. As we discuss below, compared to conventional software development, the foregrounding of the experiential dimension of use involves not only working across the boundaries of established forms of expertise, but also of the wider fields within which such expertise is situated. This has important implications not only for the way in which developer groups enact their practices within the development process, but also impacts upon the role played by user groups, thereby offering some fresh insights into the long debated question of the role of the user in software development. At the same time, as developers create their conceptualizations of a game's design, we found that the objects used to span the knowledge boundaries between groups are complemented by the emergence of the vision for the game. Our findings here lead to a further contribution on such visions as a distinctive form of boundary object that helps developer groups to evolve and share these conceptualizations. In this respect, our study provides a theoretical counterpoint to previous studies of competing frames for technology use by emphasizing the integrating role of vision and associated practices.

6.1. The User and User Experience

As outlined in our findings, the experiential dimension of use, that is, the user's experience of playing the game, was a central focus of development efforts across our case sites. We found, however, that this experiential dimension was conceptualized and realized primarily through a reliance on an integrating vision and associated practices rather than through any systematic efforts to directly engage with, or elicit the views of, users. This contrasts markedly with conventional approaches to software development in which user participation is seen as important to achieving successful outcomes (Iivari et al. 2010). In part, the absence of user participation in our study may be attributed to the difference between innovative software development that is aimed at heterogeneous users within a diversified consumer market, rather than at individuals occupying specific organizational roles. Our distinction between the creative efforts involved in addressing the experiential dimension of use, compared to productivity-oriented applications aimed at extrinsic benefits, is relevant here. These factors suggest that the views of a particular group of users may well be a poor guide for software development projects that seek competitive success by creating innovative experiences rather than meeting defined needs for greater productivity.

In these settings, it seems, "envisioning practices" can be a crucial adjunct to developers and managers' creative agency in realizing a desired user experience. One contribution of our study then, is to underline the limitations of some established models of use and the user for addressing experientially oriented software applications (Lin and Bhattacharjee 2010, Schultze and Leahy 2009, Schultze 2010).

This is not to say that the user was absent from the development process in our study, or that at the earliest stages of a project there was no market research. Indeed, as with the disagreement that arose during the gypsy quest vignette at Petname, the expectations of user groups were sometimes explicitly invoked to support a particular point of view. Such research, however, helped to inform developers' efforts to realize a particular experience of *use*, rather than direct them toward the needs of a specific group of *users*. Thus, as observed in our findings, and as highlighted by previous work on "configuring the user" (Woolgar 1991), what was ultimately important was how the user was invoked and imagined, and how this was rendered into a collective resource by developers across a project. As we observed in the gypsy quest vignette, this imagining of the user was absorbed within the evolving, cocreated vision for the game.

This privileging of vision over the conventional analysis of user needs can be seen as a consequence of development teams not only having to work across divisions in their expertise, but also the wider fields of cultural production and software production. As outlined in our findings, developers drew creatively from a range of resources originating in domains such as movie and TV production to develop the narratively structured and self-consistent features that help make gaming an immersive and flow-like experience for users (Schultze and Orlikowski 2010). This spanning of different fields was thus expressed, and enabled, through a creative and collective agency that involved individuals and groups acting outside their formal role responsibilities as developers or managers. In this respect, the relative emphasis given to creative agency over specific user needs can be seen as paralleled, and even legitimized, by relevant cultural domains such as movie production. In a study of Electronic Arts (one of the largest and most successful games developers) for example, a senior executive commented: "When is the last time you think Steven Spielberg had a focus group on what is going to make a good movie?" (Roberto and Carioggia 2003, p. 5). As with the case firms in our study, Electronic Arts relied more on "intuition, passion for playing video games and two decades of industry experience" than on market research in evaluating new games concepts (Roberto and Carioggia 2003, p. 5).

6.2. Collaborative Practices and Boundary Objects

The significance of vision in the collaborative practices observed in our study represents a further distinctive feature of games development. In relation to our first research question in particular, our analysis has shown how the envisioning practices of *surfacing*, *capturing*, and *formalizing* help to translate resources from the broad fields of cultural and software production into the development process. As several of our respondents commented, these practices enable the developers to “get it,” that is, to develop a shared interpretation of the experiential dimension of a game’s design. As the examples from our case settings demonstrate, the practices of envisioning and producing are progressively interwoven in a way that not only overcomes the boundaries between expert groups, but also fosters the emergence of a specific joint field centred on a new game.

In relation to our second research question, therefore, we can observe from our analysis how this interweaving of practices creates distinctive demands on the role played by boundary objects in this setting. Artefacts such as the concept book and the game design document were important as boundary objects in helping to represent dependencies across groups (Carlile 2002, 2004; Bergman et al. 2007). At the same time, however, the conceptualization of the desired user experience was highly reliant on an evolving vision that needed to be able to span the disparate fields of software and cultural production and supplement what could not be represented by the more conventional artefactual (Bergman et al. 2007) and informational (Berente et al. 2010) boundary objects. With such an emerging conceptual boundary object, no clear syntactic and semantic boundaries were negotiated. Despite the use of many visual and other references, no attempt was made to formally represent or specify the vision in a way that would require the subsequent translation of this representation across different domains of expertise. The vision evolved by focusing individuals’ and groups’ selection and use of cultural and other resources, and was elaborated through their creative responses to such resources. This is well illustrated by our example of the dramatization of key scenes at Petname, which shows how cross-field resources enabled the appropriation of new tools and activities into the developers’ repertoire.

This insight into the collaborative value of the vision for games development is complemented by accompanying insights into the role of nonartefactual objects in conceptualizing the user experience by spanning the boundaries of disparate fields and developing new joint fields. These new insights relate to the role of vision not as a shared and defined cognitive frame, but as evoking wider resources from beyond the existing field of computer games

development. Here we found that certain artefacts boundary objects to enable the exchange and transformation of knowledge. But when groups were collaboratively conceptualizing the game experience, boundary objects with different capabilities were required. The vision for the game, in particular, supported the ability of developer groups to span different fields, and was also closely implicated in, and emergent from, a new joint field centered on the new game itself. The importance of vision in helping to foster these joint fields can be gauged not only from the games development projects outlined in our study, but also counterfactually by the examples, which were cited among respondents across all three sites, of design failures where a coherent vision had been lacking. Recognition of the involvement of boundary objects in the successful development of new fields, and the consequent rethinking of the role and form of such objects, represents one of the important contributions of our study.

6.3. The Role of Vision in Framing Innovative Design

In response to our third research question then, we observe that the vision’s support for collaborative practices was sustained by a plethora of what we termed “fragmentary” representations that circulated among development teams. It was as a shifting collage of such representations that the vision retained the “open” and “dynamic” qualities that have previously been identified as important for collaborative work in innovative contexts (Allhutter and Hofmann 2010, Ewenstein and Whyte 2009) or in IS design situations where the capability for producing common representations is limited (Bergman et al. 2007). Though *partially* instantiated and invoked in the pages of concept books and other artefacts, the vision was an underdetermined rather than a stable concept. Other work has found that such fragments can help to produce a “cocreated scaffold,” a visual or verbal abstract representation that supports dialogue across different forms of expertise without the need to represent differences in such expertise (Majchrzak et al. 2011). Similarly, through what we term *capturing* practices, the vision for the game effectively supported a dialogue spanning different specialist groups.

With the vision for a game helping to direct collaboration toward resources from the fields of cultural production (pop culture, films, books, music, art) and software production (software coding languages, application programming interfaces, computer hardware, algorithm design, new software scripting approaches) by *evoking* as well as *representing* use experiences, our analysis shows how the resulting codevelopment of boundary objects and practices contributes to the emergence of a specific

field with its own “resources” and practices (Levina and Vaast 2005). This suggests that viewing objects as helping to span and develop different fields of practice brings to the fore the relationship between their “open-ended” and “closed” roles in supporting collaboration (Ewenstein and Whyte 2009). This underlines, and further advances, Star’s (2010) call to address the *dynamic* relationship between the “ill-structured” use of boundary objects *between* fields and their more specific “tailored uses” *within* those fields, or social worlds. At the same time, our analysis of the vision as an *emerging conceptual boundary object* provides a novel insight by linking previous work on the expressive and symbolic role of objects in creative action (Hargadon and Bechky 2006, Rafaeli and Vilnai-Yavetz 2004) to the boundary-spanning collaboration involved in software development. In relating our findings on envisioning practices to existing theory, we recognize the important contribution of previous studies on the collaborative work of conceptualizing technological design, including studies of the design process itself (Carroll 1995, Jarke and Pohl 1993). Our study echoes important elements of this work, including, for example, the widespread importance that developer teams attached to visual representations and sketches in supporting the conceptualization of design (Henderson 1991, Whyte and Cardellino 2010). However, there are also important differences. In our study, the vision is only incompletely represented through textual or visual means, and is developed as an ongoing, cocreated interpretation of the user experience, rather than a refinable approximation of the game’s design.

Another relevant strand in the literature, as noted earlier, is work on technology frames (Orlikowski and Gash 1994, Davidson and Pai 2004, Davidson 2002). Here our findings provide a counterpoint to the emphasis that such studies place on the contested, and often implicit, nature of different groups’ frames by highlighting the collaborative work across groups that enables the development of a shared conceptualization of user experience. To this extent, our findings on envisioning practices are more closely related to recent work by Leonardi (2011) on “innovation blindness,” which highlights the need for the appropriate cultural and technical resources to be selected, shared, and used in order to achieve innovative outcomes. Envisioning practices are inescapably influenced by the frames that different groups bring to the development process. As we observed in our study, however, they also enable the challenging of such frames through the surfacing and capturing envisioning practices we describe.

6.3.1. Limitations. As noted above, one limitation of our empirical account has been that it was less focussed on the conflict between groups that have been highlighted in other studies of collaboration in

software development (Allhutter and Hofmann 2010). This may be attributed in part to our focus on the distinctive practices of envisioning. Significantly, however, where contestation was observed in our study, it took the form of conflicting interpretations of the vision, and was less concerned with the organizational and professional politics emphasized in other studies (Brown et al. 2008). The priority that all groups, including management, gave to sharing and realizing the vision may be evidence of the relative importance of cultural concerns over conventional political struggles within the setting. Thus, across all three studios we observed conflicts relating to the vision, including the examples highlighted here of the weapons developers and the gypsy quest designers. Such conflicts were often resolved through collective deliberations around the vision of the desired user experience (as, for example, through our commenting episodes), rather than by an authorial intervention or the mobilization of status or organizational politics. Of course, at the same time, we recognize that the vision itself, and what constitutes a desirable user experience, is not a neutral technical question, but one that is value laden and reflective of underlying biases in norms and discourse (Allhutter and Hofmann 2010, Kerr 2002). A further limitation of the study, but an area for future research, relates to the detailed design of gameplay that our focus on the more general aspects of the user experience such as the atmosphere, style, and drama were less able to capture.

7. Conclusions

Drawing on an empirical study of computer games development, this paper explored the challenges of conceptualizing and realizing a desired user experience when it cannot be readily specified in an initial design template, nor represented within the expertise of existing groups. The analysis indicated how achieving a desired user experience required developer groups to not only work across the boundaries that arise from specialized expertise, but also across wider fields centred on cultural production and software development, respectively. We found that their ability to do this was supported by distinctive “envisioning practices,” which sustain an emerging shared vision for each game. The research contributions we make are (a) grounding these *envisioning practices* as a means of theorizing the collaborative practices centred on the user experience; (c) identifying how these practices are interwoven with the “producing practices” of computer games development, thus enabling collaboration to span expert groups and disparate fields; and (d) theorizing the role of vision as an emerging conceptual boundary object in these practices.

Viewing games development as spanning different fields underlines how far established distinctions

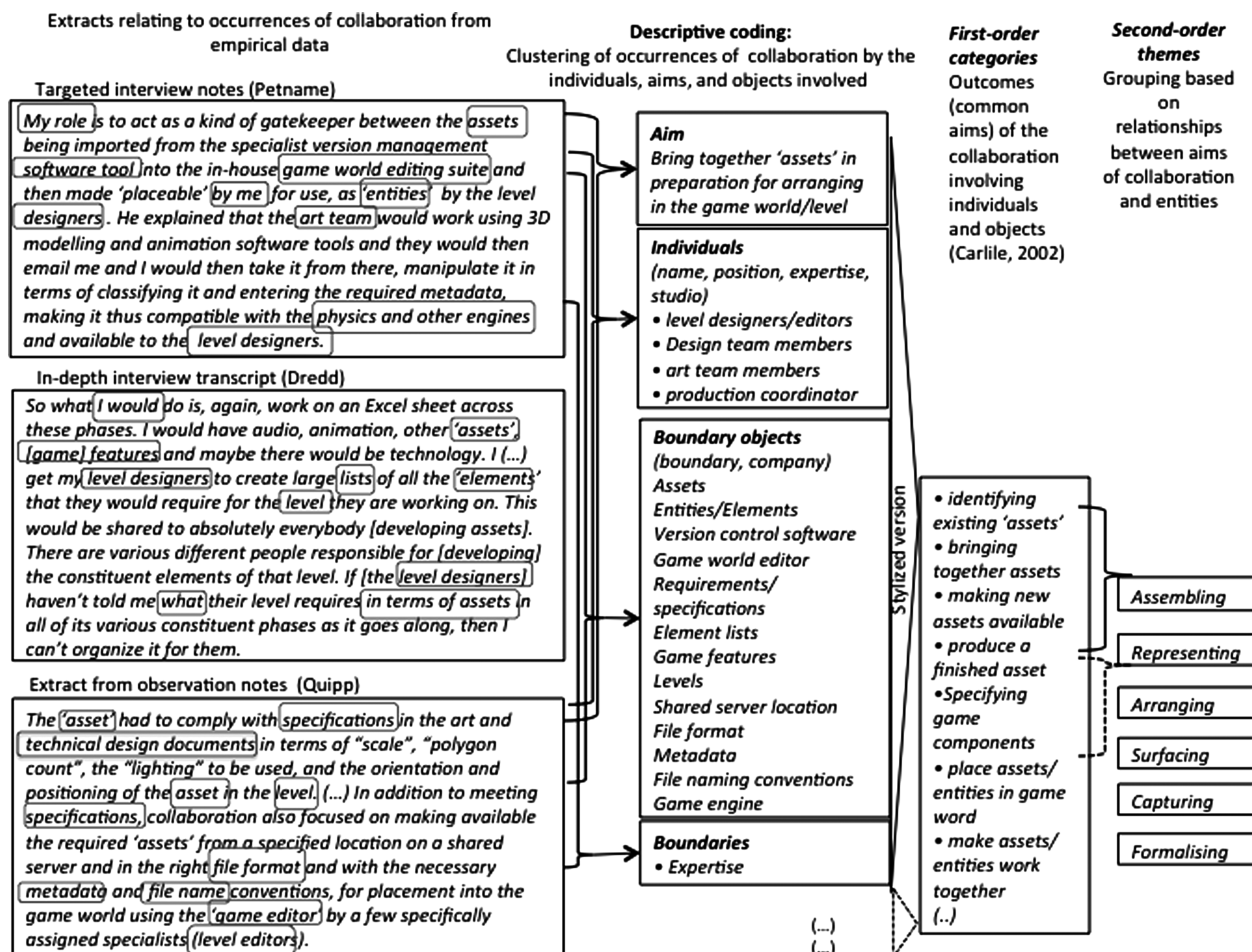
between software development and the practices seen in “creative industries” are becoming eroded. As outlined above our findings on the distinctive character of games development thus also have wider implications for information systems research, and specifically in the following areas: the emergence of cross-field practices in software development, designing user experience in games and other software products, user participation in software development, and the importance of conceptual boundary objects. For practitioners, our analysis contributes to a greater understanding of the way in which collaborative software development can address the experiential dimension of use. It extends previous studies, which have emphasized the projective role of vision, by identifying specific practices through which such a vision is shared, evolved, and realized. In contrast to studies representing vision as a broad-brush and early stage conceptualization of design, our findings suggest that extending its role throughout projects could better enable the combination of the cultural and technical resources necessary to realize a desired

user experience. At a practical level, this has implications for project management methodologies that may be too inflexible to accommodate the interweaving of mainstream development practices with “envisioning practices.” One implication for practice from our study is the highlighting of a need for new approaches to project better suited to the more elliptical paths taken by projects centered on user experience and how these might be supported through innovative project management software tools and applications.

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Appendix A. Example of Coding and Analysis of Empirical Material



Appendix B. Example of the Development of a Composite Version of the Collaborative Practices Involved in Producing a “Milestone”

Empirical accounts of collaboration with common aim	Coding process	Extract from a stylized version
<p><i>Illustrative quotation from Quipp:</i> “The project director gets involved to the point where they have to create a “milestone schedule” with a list of deliverables for the duration of the project. They are usually monthly and those deliverables contain certain parts of the game like an x amount of characters and an x amount of levels, or whatever it might be. It is important that the teams are involved in whatever they are signing-up for as it is important that the milestones that are agreed on are met as this is how we get paid monthly in arrears from our clients.”</p> <p><i>Illustrative quotation from Petname:</i> “The production phase for this one is very simple. We just have the usual milestones. At the end of the milestones you bill; at the beginning of the milestones you hand out schedules to everyone. We said for the beginning milestone we are doing this chapter of this story.”</p> <p><i>Illustrative quotation from Dredd:</i> “When milestones go wrong there’s usually money attached to it and that pays salaries and that keeps the business going. At the beginning of your project (...) you’ll be figuring out through your schedule how many people you’ll need, what the scope of your project is and you’ll be laying the groundwork for all the steps to take your project home. You’ll be drawing an initial milestone schedule out of that, which is hitting the major beats of your project as you go along.”</p>	<p><i>Clustering (Figure 2) of collaboration based on establishing the relationships and interactions between the individuals/groups and objects identified in the coding, stripping out studio-specific content and explaining variation.</i></p>	<p>“A ‘project director,’ ‘executive producer,’ or ‘senior producer’ create, with inputs from the heads of art, design, and programming, a ‘milestone schedule’ with a list of deliverables for the duration of the project. The milestones have a predetermined frequency (Quipp, Dredd monthly, Petname every six weeks) and the deliverables refer to certain parts of the game like a certain amount of characters and a certain number of levels. There can be other more specialized deliverables involved also. The teams (art, design, programming) signing-up to these deliverables. The attainment of the deliverables is then linked to the funding of the project with payments (either from external clients or for internal projects) being tied to the attainment of the milestones. Payments are released following sign-offs of the deliverables by senior production executives from the project team and representatives of the funders (either external or internal) and billed in arrears.”</p>

References

- Agarwal R, Karahanna E (2000) Time flies when you’re having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quart.* 24(4):665–694.
- Allhutter D, Hofmann R (2010) Deconstructive design as an approach for opening trading zones. Vallverdú J, ed. *Thinking Machines and the Philosophy of Computer Science: Concepts and Principles* (Idea Group Inc., Calgary, Canada), 175–192.
- Aoyama Y, Izushi H (2003) Hardware gimmick or cultural innovation? Technological, cultural, and social foundations of the Japanese video game industry. *Res. Policy* 32(3):423–444.
- Barrett M, Oborn E, Orlikowski WJ, Yates J (2012) Reconfiguring boundary relations: Robotic innovations in pharmacy work. *Organ. Sci.* 23(5):1448–1466.
- Bechky BA (2003) Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organ. Sci.* 14(3):312–330.
- Bechky BA (2006) Gaffers, gofers, and grips: Role-based coordination in temporary organizations. *Organ. Sci.* 17(1):3–21.
- Berente N, Baxterand R, Lyytinen K (2010) Dynamics of inter-organizational knowledge creation and information technology use across object worlds: The case of an innovative construction project. *Construction Management Econom.* 28(6):569–588.
- Bergman M, Lyytinen K, Mark G (2007) Boundary objects in design: An ecological view of design artifacts. *J. Assoc. Inform. Systems* 8(11):546–568.
- Boland R, Lyytinenand K, Yoo Y (2007) Wakes of innovation in project networks: The case of digital 3-D representations in architecture, engineering, and construction. *Organ. Sci.* 18(4):631–647.
- Boudreau MC, Robey D (2005) Enacting integrated information technology: A human agency perspective. *Organ. Sci.* 16(1):3–8.
- Bourdieu P (1990) *The Logic of Practice* (Polity, Cambridge, UK).
- Bourdieu P, Johnson R (1993) *The Field of Cultural Production: Essays on Art and Literature* (Columbia University Press, New York).
- Braudy L, Cohen M (2004) *Film Theory and Criticism: Introductory Readings* (Oxford University Press, New York).
- Brown AD, Stacey P, Nandhakumar J (2008) Making sense of sense-making narratives. *Human Relations* 61(8):1035–1062.
- Byrd, TA, Cossick KL, Zmud RW (1992) A synthesis of research on requirements analysis and knowledge acquisition techniques. *MIS Quart.* 16(1):117–138.
- Carlile PR (2002) A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organ. Sci.* 13(4):442–455.
- Carlile PR (2004) Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. *Organ. Sci.* 15(5):555–568.
- Carroll JM (1995) *Scenario-based design: Envisioning work and technology in system development*. (John Wiley & Sons, New York), 408.
- Chiasson MW, Davidson E (2005) Taking industry seriously in information systems research. *MIS Quart.* 29(4):591–605.

- Cohendet P, Simon LT (2007) Playing across the playground: Paradoxes of knowledge creation in the videogame firm. *J. Organ. Behav.* 28(5):587–605.
- Csikszentmihalyi M (1991) *Flow: The Psychology of Optimal Experience: Steps Toward Enhancing the Quality of Life* (Harper Collins Publishers, New York).
- Davidson E, Pai D (2004) Making sense of technological frames: Promise, progress, and potential. Kaplan B, Truex D, Wastell D, Wood-Harpe T, DeGross J, eds., *Relevant Theory and Informed Practice: Looking Forward from a 20 Year Perspective on IS Research* (Kluwer, Boston), 473–491.
- Davidson EJ (2002) Technology frames and framing: A socio-cognitive investigation of requirements determination. *MIS Quart.* 26(4):329–358.
- Deci EL (1975) *Intrinsic Motivation* (Plenum Press, New York).
- Deterding S, Sicart M, Nacke L, O'Hara K, Dixon D (2011) Gamification: Using game design elements in non-gaming contexts. *Proc. Annual Conf. Extended Abstracts on Human Factors in Comput. Systems* (ACM, New York). 2011.
- Eisenhardt K, Graebner M (2007) Theory building from cases: Opportunities and challenges. *Acad. Management J.* 50(1):25–32.
- Eisenhardt KM (1989) Building theories from case study research. *Acad. Management Rev.* 14(4):532–550.
- Engels F, McLellan D (2009) *The Condition of the Working Class in England* (Oxford University Press, New York).
- Ewenstein B, Whyte J (2007) Beyond words: Aesthetic knowledge and knowing in organizations. *Organ. Stud.* 28(5):689–708.
- Ewenstein B, Whyte J (2009) Knowledge practices in design: The role of visual representations as “epistemic objects.” *Organ. Stud.* 30(1):7–30.
- Faraj S, Sproull L (2000) Coordinating expertise in software development teams. *Management Sci.* 46(12):1554–1568.
- Green L, Miles I, Rutter J (2007) Hidden innovation in the creative sectors. Report, the National Endowment for Science, Technology, and the Arts, London.
- Hargadon AB, Bechky BA (2006) When collections of creatives become creative collectives: A field study of problem solving at work. *Organ. Sci.* 17(4):484–500.
- Hassenzahl M, Tractinsky N (2006) User experience—a research agenda. *Behav. Inform. Tech.* 25(2):91–97.
- Henderson K (1991) Flexible sketches and inflexible data bases: Visual communication, conscriptive devices, and boundary objects in design engineering. *Sci., Tech., Human Values* 16(4):448–473.
- Hesmondhalgh D (2006) Bourdieu, the media and cultural production. *Media, Culture Soc.* 28(2):211–231.
- Hsu CL, Lu HP (2004) Why do people play on-line games? An extended TAM with social influences and flow experience. *Inform. Management* 41(7):853–868.
- Iivari J, Isomaki H, Pekkola S (2010) The user—The great unknown of systems development: Reasons, forms, challenges, experiences and intellectual contributions of user involvement. *Inform. Systems J.* 20(2):109–117.
- Jarke M, Pohl K (1993) Vision driven system engineering. Prakash N, Rolland C, Pernici B, eds. *Proc. IFIP WG8.1 Working Conf. Inform. System Development Process*. (North-Holland, Amsterdam), 3–20.
- Johnson D, Wiles J (2003) Effective affective user interface design in games. *Ergonomics* 46(13–14):1332–1345.
- Kellogg KC, Orlikowski WJ, Yates JA (2006) Life in the trading zone: Structuring coordination across boundaries in postbureaucratic organizations. *Organ. Sci.* 17(1):22–44.
- Kerr A (2002) Representing users in the design of digital games. *Proc. Comput. Games and Digital Cultures Conf., Tampere, Finland*.
- Lamb R, Kling R (2003) Reconceptualizing users as social actors in information systems research. *MIS Quart.* 27(2):197–236.
- Langley A (1999) Strategies for theorizing from process data. *Acad. Management Rev.* 24(4):691–710.
- Leonardi PM (2011) Innovation blindness: Culture, frames, and cross-boundary problem construction in the development of new technology concepts. *Organ. Sci.* 22(2):347–369.
- Leonardi PM, Barley SR (2010) What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing. *Acad. Management Ann.* 4(1):1–51.
- Levina N (2005) Collaborating on multiparty information systems development projects. *Inform. Systems Res.* 16(2):109–130.
- Levina N, Vaast E (2005) The emergence of boundary spanning competence in practice: Implications for implementation and use of information systems. *MIS Quart.* 29(2):335–363.
- Lin C-P, Bhattacharjee A (2010) Extending technology usage models to interactive hedonic technologies: A theoretical model and empirical test. *Inform. Systems J.* 20(2):163–181.
- Majchrzak A, More PHB, Faraj S (2012) Transcending knowledge differences in cross-functional teams. *Organ. Sci.* 23(4):951–970.
- Monteiro E, Jarulaitisand G, Hepsø V (2012) The family resemblance of technologically mediated work practices. *Inform. Organ.* 22(3):169–187.
- Nicolini D (2009) Zooming in and out: Studying practices by switching lenses and trailing connections. *Organ. Stud.* 30:1391–1418.
- Okhuysen GA, Bechky BA (2009) Coordination in organizations: An integrative perspective. *Acad. Management Ann.* 3:463–502.
- Orlikowski WJ (2000) Using technology and constituting structures: A practice lens for studying technology in organizations. *Organ. Sci.* 11(4):404–428.
- Orlikowski WJ (2010) Practice in research: Phenomenon, perspective, and philosophy. Golsorkhi D, Rouleau L, Seidl D, Vaara E, eds. *The Cambridge Handbook of Strategy as Practice* (Cambridge University Press, Cambridge, UK), 22–33.
- Orlikowski WJ, Baroudi JJ (1991) Studying information technology in organizations: Research approaches and assumptions. *Inform. Systems Res.* 2(1):1–28.
- Orlikowski WJ, Gash DC (1994) Technological frames—Making sense of information technology in organizations. *ACM Trans. Inform. Systems* 12(2):174–207.
- Pettigrew AM (1990) Longitudinal field research on change: Theory and practice. *Organ. Sci.* 1(3):267–292.
- Potts J, Cunningham S, Hartley J, Ormerod P (2008) Social network markets: A new definition of the creative industries. *J. Cultural Econom.* 32(3):167–185.
- PricewaterhouseCoopers (2008) Global entertainment and media outlook: 2008–2012. (PricewaterhouseCoopers, New York).
- Rafaeli A, Vilnai-Yavetz I (2004) Emotion as a connection of physical artifacts and organizations. *Organ. Sci.* 15(6):671–686.
- Rip A, Misa TJ, Schot J (1995) *Managing Technology in Society* (Pinter Publishers, London).
- Roberto MA, Carioggia GM (2003) *Electronic Arts: The Blockbuster Strategy* Harvard Business School Case 304-013, Cambridge, MA.
- Schatzki TR, Knorr-Cetina K, von Savigny E (2001) *The Practice Turn in Contemporary Theory* (Routledge, New York).
- Schultze U (2010) Embodiment and presence in virtual worlds: A review. *J. Inf. Technol.* 25(4):434–449.
- Schultze U (2011) The avatar as sociomaterial entanglement: A performative perspective on identity, agency and world-making in virtual worlds. *Proc. Internet. Conf. Inform. Systems* (Association of Information Systems, Shanghai), <http://aisel.aisnet.org/ais2011/proceeding/hci/11>.
- Schultze U, Leahy MM (2009) The avatar-self relationship: Enacting presence in second life. *Proc. Internat. Conf. Inform. Systems* (Association of Information Systems, Phoenix), <http://aisel.aisnet.org/ais2009/12>.

- Schultze U, Orlikowski WJ (2010) Research commentary—Virtual worlds: A performative perspective on globally distributed, immersive work. *Inform. Systems Res.* 21(4):810–821.
- Stacey P, Nandhakumar J (2009) A temporal perspective of the computer game development process. *Inform. Systems J.* 19(5):479–497.
- Star SL (2010) This is not a boundary object: Reflections on the origin of a concept. *Sci., Tech. Human Values* 35(5):601–617.
- Star SLh, Griesemer JR (1989) Institutional ecology, “translations” and boundary objects: Amateurs and professionals in Berkeley’s museum of vertebrate zoology, 1907–1939. *Soc. Stud. Sci.* 19(3):387–420.
- Swanson EB, Ramiller NC (1997) The organizing vision in information systems innovation. *Organ. Sci.* 8(5):458–474.
- Thom J, Millen D, DiMicco J (2012) Removing gamification from an enterprise SNS. *Proc. Conf. Comput. Supported Cooperative Work* (ACM, New York).
- Tschang FT (2007) Balancing the tensions between rationalization and creativity in the video games industry. *Organ. Sci.* 18(6):989–1005.
- Tschang TF, Szczypula J (2006) Idea creation, constructivism and evolution as key characteristics in the videogame artifact design process. *Eur. Management J.* 24(4):270–287.
- Van der Heijden H (2004) User acceptance of hedonic information systems. *MIS Quart.* 28(4):695–704.
- Walsham G (1995) Interpretive case studies in IS research: Nature and method. *Eur. J. Inform. Systems* 74(4):74–81.
- Wasko M, Teigl R, Leidner D, Jarvenpaa S (2011) Stepping into the Internet: New ventures in virtual worlds. *MIS Quart.* 35(3):645–652.
- Whyte JK, Cardellino P (2010) Learning by design: Visual practices and organizational transformation in schools. *Design Issues* 26(2):59–69.
- Winter SJ, Butler BS (2011) Creating bigger problems: Grand challenges as boundary objects and the legitimacy of the information systems field. *J. Inf. Technol.* 26(2):99–108.
- Woolgar S (1991) Configuring the user: The case of usability trials. Law J, ed. *A Sociology of Monsters: Essays on Power, Technology and Domination* (Routledge, London), 58–95.
- Zackariasson P, Styhre A, Wilson TL (2006a) Phronesis and creativity: Knowledge work in video game development. *Creativity and Innovation Management* 15(4):419–429.
- Zackariasson P, Walfisz M, Wilson TL (2006b) Management of creativity in video game development. *Services Marketing Quart.* 27(4):73–97.